



Center for Integrated Nano-Technologies

Operating Procedure for SUSS MJB3 Mask Aligner (ALIGN1)

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1. PURPOSE

This document provides information for the safe use and operation of the Karl Suss MJB3 Mask Aligner (ALIGN1) located in Room 1523 of the Center for Integrated Nano-Technologies (Bldg 518). Any questions beyond the scope of this document should be directed to the equipment owner.

2. ACRONYMS

Many pieces of equipment and procedures are known by their associated acronym, it is important to become familiar with the following list to avoid confusion.

SNL- Sandia National Labs
CINT- Center for Integrated Nano-Technologies
SOP/OP- Standard Operating Procedure/Operating Procedure
DVPG- Digital Video Pattern Generator
ES&H – Environmental Safety and Health
S&S- Safeguards and Security
QA- Quality Assurance
PM- Preventative Maintenance
UV- Ultra Violet

3. DEFINITIONS

Authorized User- Personnel with the required training and subsequent approval of the Integration Lab manager to use said equipment.

CINT Key Operator- Designated Key Operators are qualified to perform tool specific training of Authorized Users, and are responsible for the maintenance of the equipment.

Visitor- Personnel trained in the cleanroom overall safety and gowning procedures, but not authorized to operate equipment.

ES&H Officer – Provides ES&H, S&S, and QA for CINT activities.

Wafer Chuck- Circular mount that holds the substrate.

4. RESPONSIBILITIES

It is the responsibility of every employee, contractor, and visitor to ensure a safe and healthy working environment. There is no experiment or procedure at Sandia that is so urgent that it needs to be done in an unsafe manner, and it is everyone's obligation to refuse to do work that he or she believes to be unsafe. If there is an activity or situation that is of concern it is their immediate responsibility to contact a supervisor or ES&H representative.

5. TRAINING

Prior to using Lithography tools or processes, users must complete all IL Unescorted Access (ILUA) Corporate and Operations training.

5.1 Corporate training

Integration Lab Authorized Users shall complete the Corporate training specified in the *IL General OP*. Additional Corporate training classes may be required for specific activities.

5.2 Operations training

Required Operations training:

- IL Lithography OP
- OAI Aligner OP

5.3 Tool Specific training

Prior to using ALIGN1 the Key Operator of ALIGN1 must instruct the potential Authorized User on the safe and proper operation of the tool to minimize the risk to the user and the tool. After completion of the tool specific training, the Key Operator will provide a recommendation to the Integration Laboratory Manager for or against the tool access of the potential Authorized User. Once training is complete the user will be able to perform:

- Wafer chuck replacement
- Frontside mask alignment
- Frontside exposures

6. APPROVAL, NOTIFICATIONS, SCHEDULING

After reading and signing all applicable OP's, finishing all associated training, and receiving the express permission from the Integration Lab manager the Authorized User will be issued a new Integration Lab badge indicating that they are allowed to use the mask aligners. They will then be given access to schedule the tool in the on-line tool calendar.

7. SAFETY PRECAUTIONS AND LIMITATIONS

General safety precautions are addressed in the IL General OP, which is a prerequisite for IL Lithography training. During normal operation, The OAI Mask Aligner is an inherently safe tool and has limited possibility of exposure to hazards. Only CINT Key Operator may open the tool or perform maintenance. However, to better inform the user we have included the following information on the internal hazards of the tool.

7.1 UV Burn Hazard

Prolonged exposure to diffused reflection from the output beam or a few seconds of direct output beam exposure can cause skin burns or burns to the outer layer of the eye. As with any UV light source always wear UV filtered glasses to protect eyes and limit exposure to UV radiation. During normal operation there should never be direct UV exposure.

7.2 Lamp Explosion

During operation the light source is subjected to extremely high internal pressure, and there is the possibility of a lamp exploding. A lamp explosion can be due to contamination of the quartz envelope, internal strains, or physical abuse. Handle the lamps only by metal end caps and DO NOT TOUCH the quartz with bare hands. A lamp explosion can damage other internal components and it's important to take precautions to avoid one as they can be both dangerous and costly. In the event of a lamp explosion clear the area of personnel and immediately contact the tool owner so that the appropriate maintenance can be performed. Also be aware that the lamp does contain mercury, and if the lamp explodes there will be minute amounts of liquid mercury inside light source housing.

7.3 Ozone Poisoning

Do not operate the system if proper room ventilation is not available as Deep UV lamps produce significant levels of ozone.

7.4 Mechanical pinch hazards

Any equipment that has moving parts will have some sort of pinch hazard. The mask aligner has several moving pieces, some of which move independently of manual operation. It is important to be alert when working near moving parts. Some examples are the UV exposure hood, the top side alignment optics, bottom side alignment optics, and the alignment stage.

8. SPECIAL TOOLS, EQUIPMENT, PARTS, AND SUPPLIES

All parts and supplies needed for using this machine will be located in the cabinet against the wall, to the left of the machine. The cabinet contains masks and wafer chucks. Anything beyond routine use of the machine will require additional tools, however maintenance should only be performed by Key Operators.

9. OPERATING AND MAINTENANCE PROCEDURES

Operation of ALIGN1 should only be executed by an Authorized User or the Key Operator. The mask aligner will perform top side alignment by placing the substrate underneath the mask and aligning the substrate target to the mask target. The mask aligner can expose irregular shaped substrates of differing thickness up to a 3 inch standard wafer. ALIGN1 is equipped with a 350W mercury short-arc lamp which provides primary exposure wavelengths of 350-450nm. It contains a high precision alignment stage that allows for alignment accuracies to 0.1 microns. ALIGN1 can perform exposures in vacuum, hard, soft, or optional proximity contact. Under optimum conditions it has a resolution of 0.6 microns. Below is a picture labeling parts that will be referred to in the Operating Procedure (Figure 9-1).

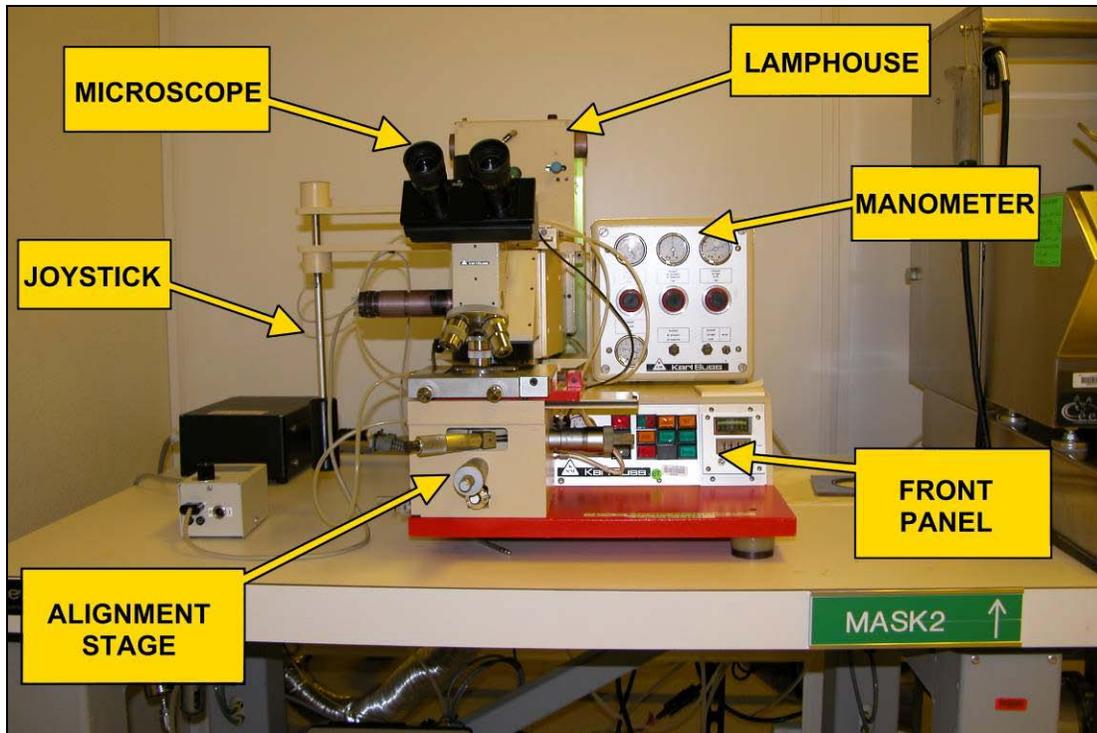


Figure 9-1 ALIGN1 Suss MJB3 mask aligner.

9.1 Set-up and Preparation

When you come into the lithography lab (Room 1523), ALIGN1 should be in its “steady state” condition. This means that most applicable power supplies, gas, and vacuum should already be set up for use. If system is not in steady state condition please contact equipment owner and/or a Key Operator to turn on system.

Before starting any work on this tool check to make sure you’ve done all the following:

- ✓ Brought/have all masks
- ✓ Have exposure recipe (hard/soft/vacuum contact, exposure time)
- ✓ Brought needed substrate(s)
- ✓ Checked manometer box to ensure proper settings on pressure and nitrogen gauges

9.2 Operation for Front Side Exposure

STEP 1- Loading the mask. Begin by loosening the two knobs which clamp the maskholder onto the stage and removing the maskholder (Figure 9-2).

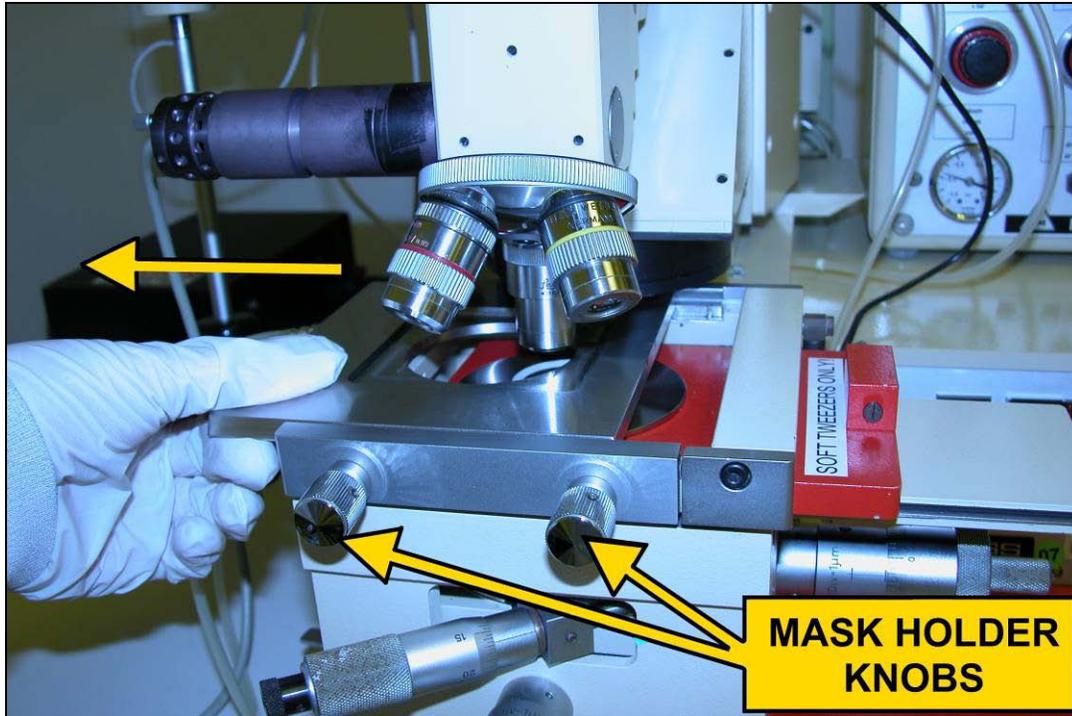


Figure 9-2 Turn mask holder knobs counterclockwise and pull to the left to remove.

Carefully place the maskholder on a flat surface with the vacuum groove face up (Figure 9-3). Check that the MASK VACUUM button on front panel (Figure 9-4) is in OFF position (Pushed in is ON position, pressed out is OFF position). Carefully place mask on maskholder with the patterned side face up and press MASK VACUUM button to engage vacuum. The maskholder can now be flipped over and reinserted into the stage. **Please be extra careful when there is a mask in the holder. It is VERY easy for the mask to fall off the holder. It is a good idea to keep your hand under (but not touching!) the mask as it is put into stage.**

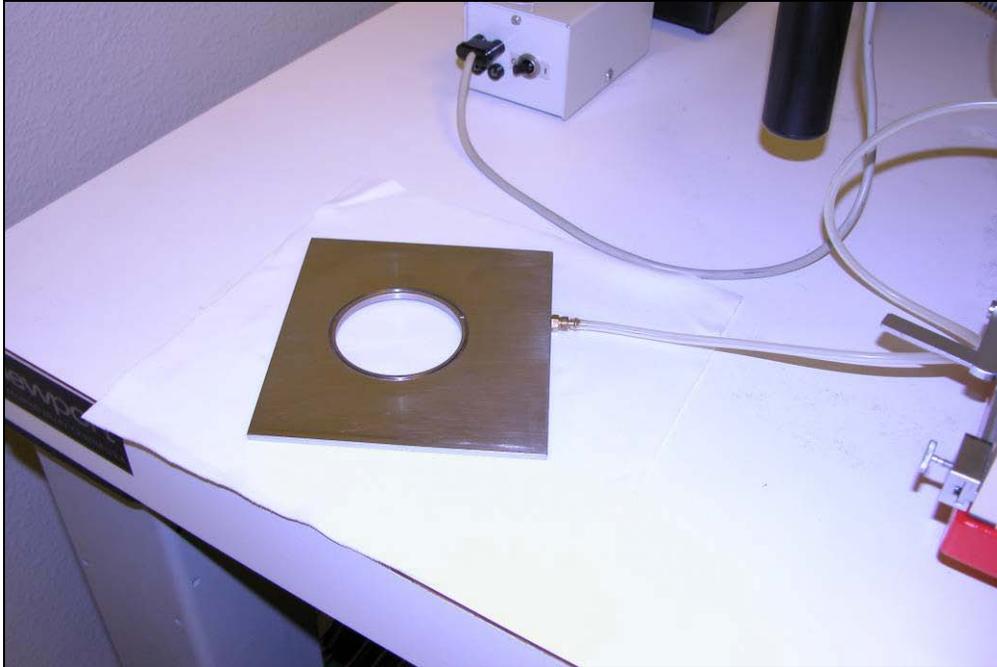


Figure 9-3 Removed mask holder.



Figure 9-4 Front Panel

STEP 2- Loading substrate. Pull the wafer chuck out to ensure that correct chuck size is present. If a replacement is needed it can be found on the table to the left of the tool. Place the substrate on the chuck. The system can run vacuum, soft, or proximity exposure. If using a vacuum contact ensure that substrate covers all vacuum holes, or that substrate is covering holes symmetrically. This ensures that there is little mechanical stress on the substrate due to the vacuum. Then press the VACUUM CHAMBER button. This causes the vacuum between mask and substrate to be pulled immediately prior to exposure. For smaller substrate pieces a soft contact exposure may be more desirable, as the exposure is performed using only

mechanical pressure of the substrate against the mask. Pressing the SOFT CONTACT button in put system into soft contact mode. Proximity exposure may also be necessary for particular processes. This distance is determined by using the separation lever (Figure 9-5) and may be adjusted to a maximum separation distance of 150 microns.

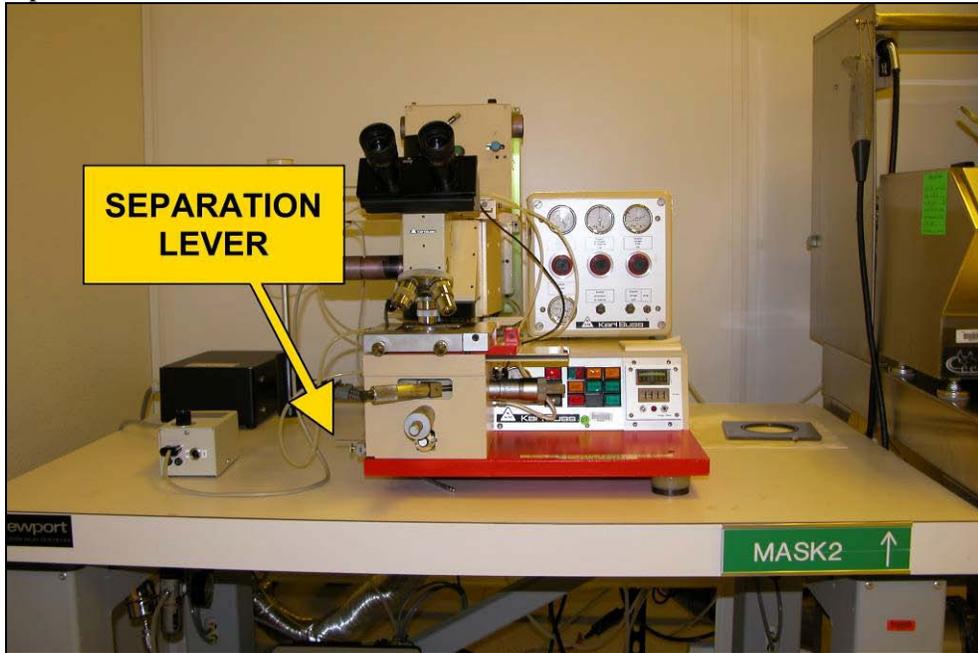


Figure 9-5 Separation lever.

The system must be in ST mode (not HP). Note that even when using the proximity exposure mode it is still necessary to perform contacts between mask and substrate prior to alignment in order to perform mask to substrate parallelity compensation. Once contact mode has been chosen insert chuck back into stage and bring the substrate into contact with the mask by rotating the contact lever 180 degrees counterclockwise. The CONTACT light on the front panel will illuminate.

STEP 3- Focus microscope. First ensure the microscope lamp is on by going to the power box located to the left of the tool (Figure 9-6) and turning light on. The intensity can be adjusted using the adjustment knob.



Figure 9-6 Microscope lamp power box.

Focus the microscope on the mask and substrate using the focus adjustment knob. The microscope focus control incorporates a combined coarse-fine adjustment. If the focus adjustment is turned in one direction only, the coarse focusing motion will be effective. The fine adjustment is automatically engaged as soon as the slightest turn is made in the opposite direction. Remember that a low magnification objective should be used for coarse alignment and the magnification steadily increased until satisfactory alignment is obtained.

STEP 4- *Align substrate and mask.* To align substrate it must be removed from contact with the mask. Pull the separation level toward the front of the tool until sufficient separation is obtained. The CONTACT light will go out and the SEPARATION light will illuminate. Now the substrate can be aligned to the mask using the X, Y, and THETA micrometers (Figure 9-7). The X and Y micrometers contain both a coarse and fine adjustment. The aligner is equipped with a standard field microscope. The two objectives are aligned to two alignment features on opposite sides of the substrate using the microscope joystick and the objective separation controls. The upper button on the joystick handle controls the Y motion, lower the X motion, and it can be moved in any direction by holding both down simultaneously. Once satisfactory alignment is obtained move the substrate back into contact with the mask by pushing the separation lever all the way to its rearmost position. The SEPARATION light will go out and CONTACT will illuminate. Always double check that alignment has been maintained in CONTACT mode. If not separate mask and substrate and reposition until CONTACT mode is adequately aligned.

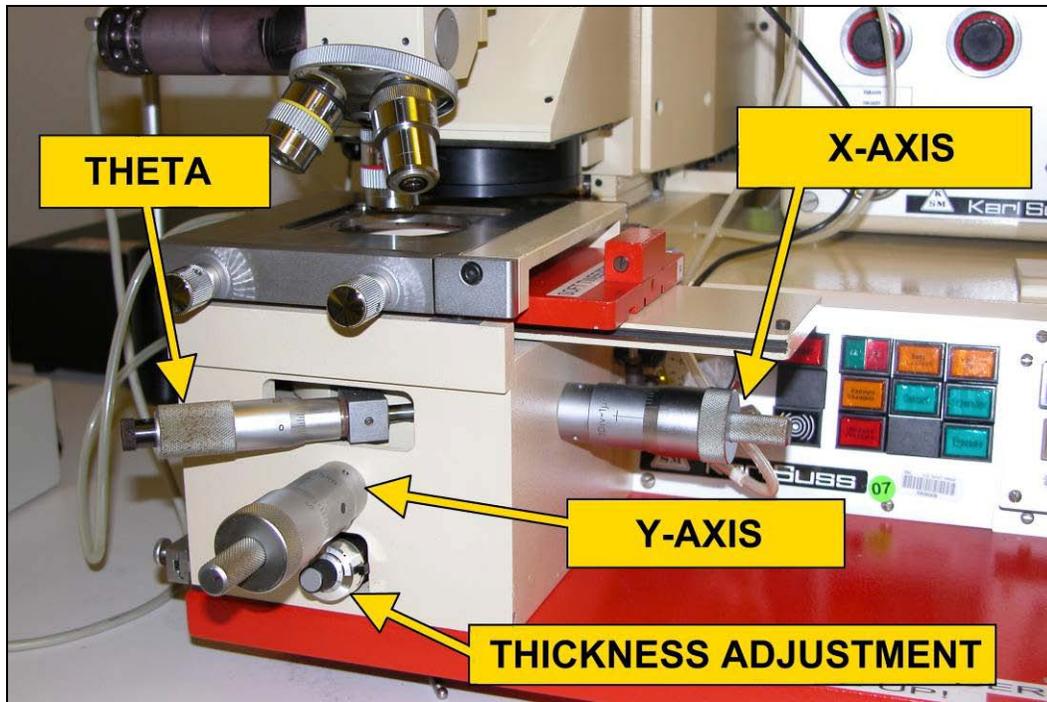


Figure 9-7

Also note: ALIGN1 is equipped with a device to maintain constant contact pressure when processing substrates of various thicknesses. Alternatively this device may be used to vary the contact pressure for a given wafer thickness. One revolution of the thickness adjustment knob (Figure 9-5) corresponds to a 150 micron variation of substrate thickness or contact pressure. Rotate the knob counterclockwise to increase the contact pressure or subtract wafer thickness, or clockwise to decrease contact pressure or add wafer thickness. Upon installation a reference mask/substrate were used to set up a particular contact pressure. Please see the key operator for specifications.

STEP 5- Exposure. The substrate is now ready for exposure. Set the exposure time on the timer located at the right end of the front panel. Please note where the decimal is located on the timer to ensure accurate timing (in seconds). If vacuum contact is desired ensure that the HP button is illuminated. The HP mode runs through a series of steps for highest resolution vacuum contact. If soft contact is desired press the SOFT CONTACT button. Once contact mode is selected press the EXPOSURE button. The lamp hood will move and the mask will be exposed for desired amount of time. Once exposure is complete the system will return to original position.

STEP 6- Unload the substrate. Rotate the contact level 180 degrees clockwise (toward the front of the machine), releasing the substrate from the mask. Pull the transport slide carefully to the right and remove the substrate from the chuck.

STEP 7- Unload the mask from holder. Loosen mask holder knobs and slide holder out. Set mask holder on table with mask facing up. Press the MASK VACUUM button so that light is off (i.e. it is pressed out). Then remove the mask and replace the holder.

9.4 Clean-up/Shut down

